CLAIMS

We Claim:

1. An etching method comprising:

loading a workpiece into an etching chamber, the microstructure comprising a first area to be removed by a spontaneous vapor phase chemical etchant and a second area to remain after the first area being removed, wherein the second area comprises an intermetallic compound;

providing the spontaneous vapor phase etchant to the etching chamber; and

removing the first area while leaving behind the second area.

2. The method of claim 1, wherein the intermetallic compound comprises an early transition metal selected from column 4 in the periodic table.

3. The method of claim 1, wherein the intermetallic compound comprises an element that is Tc or Re.

4. The method of claim 1, wherein the intermetallic compound comprises an element that is a late transition metal.

5. The method of claim 4, wherein the intermetallic compound comprises an element that is Ru, Rh, Os, Ir, or Pt.

6. The method of claim 1, wherein the intermetallic material is selected from the group consisting of $NiAl_x$ and $TiNi_x$.

7. The method of claim 1, wherein the intermetallic material is VAl_x, WTe_x, $TiFe_x$, $TiPd_x$, $AlPd_x$, $MoPd_x$, $MoNi_x$, $MoFe_x$, $CoCr_x$, $CoMn_x$, NiW_x, NiV_x, $NiTi_xAl_y$, $NbAl_x$, $MoPd_x$, $AlCu_x$ $CuZn_x$, or $TaAl_x$.

8. The method of claim 1, wherein the first area comprises a material that is elemental metal, metalloid, metal alloy, metal silicide, W_xN or TaN_x.

9. The method of claim 1, wherein the workpiece is a micromirror array.

10. The method of claim 1, wherein the workpiece is a microelectromechanical device.

11. The method of claim 1, wherein the chemical etchant comprises a chemical species that is selected from the group consisting of: interhalogens, noble gas halides and HF.

12. The method of claim 11, wherein the interhalogen comprises bromine trifluoride.

13. The method of claim 11, wherein the noble gas halide comprises xenon difluoride.

14. The method of claim 11, wherein the chemical etchant is HF.

15. The method of claim 11, wherein vapor phase etchant further comprises a diluent gas that is a noble gas.

16. The method of claim 1, wherein the workpiece is a microstructure comprising a silicon substrate.

17. The method of claim 16, wherein the first area comprises amorphous silicon; and wherein the microstructure further comprises a structural layer and a barrier layer disposed between the structural layer and the first area.

18. The method of claim 16, further comprising: removing the barrier layer disposed between the structural layer and the first area.

19. The method of claim 1, wherein the second area further comprises O or N.

20. The method of claim 16, wherein the O or N in the second area is 15 atomic % or less in weight.

21. The method of claim 16, wherein the O or N in the second area is 5% atomic or less in weight.

22. The method of claim 16, wherein O or N in the second area is in a form of TiO_x, TiN_x, AlO_x or AlN_x.

23. The method of claim 1, wherein the intermetallic compound comprises an early transition metal selected from column 5 in the periodic table.

24. The method of claim 1, wherein the intermetallic compound comprises an early transition metal selected from column 6 in the periodic table.

25. The method of claim 1, wherein the intermetallic compound is $AlTi_x$.

26. The method of claim 25, wherein the workpiece further comprises a barrier layer that remains after removal of the first area.

27. A method comprising:

forming a workpiece, comprising:

providing a substrate;

depositing a first and second sacrificial layer on the substrate; and

forming a first and second structural layers on the sacrificial layers,wherein the first and second structural layers comprises an intermetallic compound;

loading the workpiece to an etching chamber; and

removing at least a portion of the first and second sacrificial layers using a spontaneous vapor phase chemical etchant.

28. The method of claim 27, wherein the intermetallic compound comprises an early transition metal selected from column 4 in the periodic table.

29. The method of claim 27, wherein the intermetallic compound comprises an element that is Tc or Re.

30. The method of claim 27, wherein the intermetallic compound comprises an element that is a late transition metal.

31. The method of claim 30, wherein the intermetallic compound comprises an element that is Ru, Rh, Os, Ir, or Pt.

32. The method of claim 27, wherein the intermetallic material is selected from the group consisting of Ni_xAl_y and TiNi.

33. The method of claim 27, wherein the intermetallic material is VAl_x, WTe_x, $TiFe_x$, $TiPd_x$, $AlPd_x$, $MoPd_x$, $MoNi_x$, $MoFe_x$, $CoCr_x$, $CoMn_x$, NiW_x, NiV_x, $NiTi_xAl_y$, $NbAl_x$, $MoPd_x$, $AlCu_x$ $CuZn_x$, or $TaAl_x$.

34. The method of claim 27, wherein the first area comprises a material that is elemental metal, metalloid, metal alloy, metal silicide, W_xN or TaN_x.

35. The method of claim 27, wherein the workpiece is a micromirror array.

36. The method of claim 27, wherein the workpiece is a microelectromechanical device.

37. The method of claim 27, wherein the chemical etchant comprises a chemical species that is selected from the group consisting of: interhalogens, noble gas halides, and HF.

38. The method of claim 37, wherein the interhalogen comprises bromine trifluoride.

39. The method of claim 37, wherein the noble gas halide comprises xenon difluoride.

40. The method of claim 37, wherein the chemical etchant is HF.

41. The method of claim 37, wherein vapor phase etchant further comprises a diluent gas that is a noble gas.

42. The method of claim 27, wherein the workpiece is a microstructure comprising a silicon substrate.

43. The method of claim 42, wherein the first area comprises amorphous silicon; and wherein the microstructure further comprises a structural layer and a barrier layer disposed between the structural layer and the first area.

44. The method of claim 43, further comprising: removing the barrier layer disposed between the structural layer and the first area.

45. The method of claim 27, wherein the second area further comprises O or N.

46. The method of claim 45, wherein the O or N in the second area is 15 atomic % or less in weight.

47. The method of claim 45, wherein the O or N in the second area is 5 atomic % or less in weight.

48. The method of claim 45, wherein O or N in the second area is in a form of TiO_x, TiN_x, AlO_x or AlN_x.

49. The method of claim 27, wherein the intermetallic compound comprises an early transition metal selected from column 5 in the periodic table.

50. The method of claim 27, wherein the intermetallic compound comprises an early transition metal selected from column 6 in the periodic table.

51. The method of claim 27, wherein the intermetallic compound is $AlTi_x$.

52. The method of claim 51, wherein the workpiece further comprises a barrier layer that remains after removal of the first area.

53. A method for making a microstructure, the method comprising:

depositing a sacrificial material on a substrate, the sacrificial material comprising a metal;

depositing a structural layer after depositing the sacrificial material, wherein the structural layer comprises a material other than the sacrificial material, and wherein the material of the structural layer comprises an intermetallic compound; and

removing the sacrificial material with a spontaneous vapor phase chemical etchant.

54. The method of claim 53, wherein the sacrificial material comprises at least 25 percent in weight of said metal.

55. The method of claim 53, wherein the sacrificial material comprises at least 50 percent in weight of said metal.

56. The method of claim 53, wherein the sacrificial material comprises at least 90 percent in weight of said metal.

57. The method of claim 53, wherein the chemical etchant is selected from a group comprising interhalogen, noble gas halide and HF.

58. The method of claim 57, wherein the interhalogen comprises bromine trifluoride.

59. The method of claim 57, wherein the noble gas halide comprises xenon difluoride.

60. The method of claim 57, wherein the etchant is mixed with a diluent gas that is He, N_2, Ne, Ar, Ke, or Xe.

61. The method of claim 59, wherein the metal of the sacrificial material is a transition metal that is an early transition metal.

62. The method of claim 61, wherein the metal is a sputtered elemental metal material.